



US Army Corps
of Engineers
Detroit District

Great Lakes Update



1997 Annual Summary

Water levels on all of the Great Lakes were significantly above average through 1997 with peak levels on all but Lake Superior exceeding those of 1996.

Precipitation and Temperatures

Lake levels follow a seasonal pattern, normally rising in the spring, peaking in the summer and declining in the fall to a low during the winter. This pattern is shown by the long-term average indicated on the hydrographs contained in the *Monthly Bulletin of Lake Levels for the Great Lakes*.

The winter of 1996-97 in the U.S. will be remembered for the great flood of the Red River of the North that devastated Fargo, North Dakota, and threatened Winnipeg, Manitoba. The flood conditions were caused by several heavy snowstorms tracking across the central plains northeast through Wisconsin, followed by persistent waves of cold weather. While much of the Great Lakes basin escaped severe snow storms, the lake effect snow machine provided some hefty totals on the southern shore of Lake Superior and northern half of the Lakes Michigan-Huron basin.

Last winter was the second consecutive record breaker for snowfall in many Upper Peninsula, Michigan counties. The National Weather Service (NWS) Office which serves Herman, Bergland, Munising and Marquette reported all time snowfall records for these areas. Herman, a small town in the western UP, where the average annual snowfall is 240 inches, received a whopping 384 inches of snow. Stubborn cold weather during the normal March and April snowmelt period set the stage for the rapid runoff when the weather suddenly warmed. This caused

many northern rivers in the Great Lakes basin to reach near bankfull conditions, resulting in some flooding in river communities.

According to the NWS, temperatures across the entire Great Lakes basin were close to normal for the winter season, with the north country tending to be colder and the south warmer. Snowfall was at, or below seasonal norms south of a line between Milwaukee, WI to Saginaw, MI. However, during the December through March winter period, the Lake Erie basin experienced 133% of its normal precipitation as more precipitation fell in the form of rain. During the spring, summer and fall, temperatures across the Lakes Michigan-Huron, Erie and Ontario basins were cooler than normal much of the time.

Consequently, the end of 1996 high water levels of the southern Great Lakes remained high and compounded sporadic erosion problems when late winter and spring storm waves pounded unprotected shorelines. After the 1997 snowmelt the northern lakes experienced dryer than normal months.

Precipitation over the Great Lakes basin for 1997 was below normal based on preliminary records of the U.S. National Weather Service and Canadian Atmospheric Environment Service. Dry periods were experienced in April, June and July, and September through December, with the remaining months being wetter than normal. Total basin-wide precipitation for 1997 was 32.31 inches, or 0.89 inches below normal. Figure 1 compares the monthly precipitation for 1996 and 1997 to the long-term average for the entire basin.

Great Lakes Basin Precipitation

Deviation from Long-term Average (1900-1995)

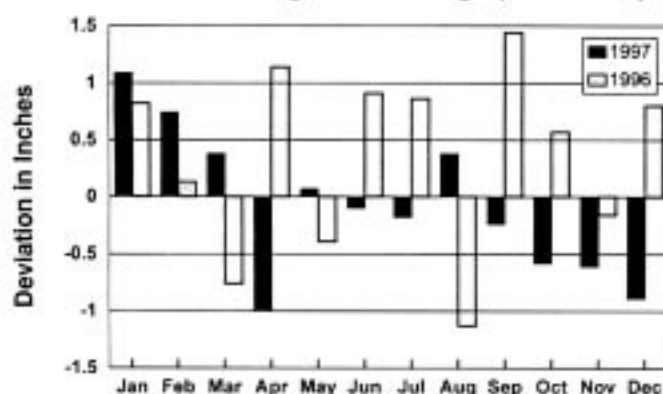


Figure 1

Lake Levels

The *Monthly Bulletin of Lake Levels for the Great Lakes*, which fosters this annual summary, graphically shows the fluctuations of water levels on the Great Lakes for the years 1996 and 1997. Lake Superior levels started 1997 at 602.33 feet, about 9 inches above the January long-term average, and also about 9 inches above the January 1996 level. Lake Superior levels remained above average into July peaking at 602.85 feet, about 8 inches above the July long-term average, before the seasonal decline began. From July through December, levels fell, ending the year at 601.77 feet, about 1 inch below average for the month.

Lakes Michigan-Huron levels began the year at 580.02 feet, about 17 inches above the January long-term average, and also about 17 inches above the previous January starting level. The lake peaked in July at 581.36 feet, about 22 inches above the July long-term average. Levels then declined through December, ending the year at 579.82 feet, about 13 inches above average for the month.

Lake St. Clair's levels started the year at 575.52 feet, about 23 inches above the January long-term average. The seasonal rise was slowed in February by ice in the St. Clair River. Levels rose to a peak of 576.97 feet in June and July. Levels fell from July through December, ending the year at 575.33 feet, about 17 inches above average for the month.

Lake Erie levels began the year at 572.63 feet, about 22 inches above the January long-term average, and about 19 inches above the January 1996 level. The June mean level

was 574.21 feet, about 28 inches above average and about 1 inch below the 1986 period-of-record high. On June 7 the levels peaked at a daily mean of 574.34 feet, about 1 inch above the 1986 high. The lake declined through December, ending the year at 572.51 feet, about 20 inches above average for the month.

Lake Ontario started the year at 245.31 feet, about 9 inches above the January long-term average, and about 7 inches above the January 1996 starting level. The lake reached a peak in May of 247.28 feet, about 15 inches above average. Levels then declined through December, ending the year at 244.68 feet, about 2 inches above average for the month.

Storms

The Great Lakes Storm Damage Reporting System (GLSDRS) was developed in 1993 by the Chicago District, Corps of Engineers. The system monitors hydrological and meteorological data (water levels, wave heights, wind speed and wind direction) in order to identify storm activity on the Great Lakes. Subsequent telephone surveys are conducted to collect damage information for the impacted areas. During the period January 1, to December 1, 1997, 17 telephone surveys were conducted, yielding 917 interviews. These interviews primarily covered the southeastern Lake Michigan shoreline in Berrien and Van Buren, MI counties, and the southeastern Lake Erie shoreline in Chautauqua and Erie, NY counties. Those interviews were selected randomly from a qualified population of 9,102 in the counties which were surveyed. Damages reported to structures, contents, vehicles, landscaping, shore protection, docks, boats, etc., were estimated by property owners to be about \$321,000. GLSDR samples approximately 10% of the riparian property owners in affected areas; thus, the total damages for 11 months of 1997 are estimated by this system to be about \$2,900,000, when applied to all of the shoreline areas affected by the storms. Articles on development and use of the system were presented in *Great Lakes Update* issues No. 104 (March 1994), No. 113 (December 1994) and No. 121 (August 1995).

Lake Superior Regulation

In 1997 the International Lake Superior Board of Control (ILSBC) continued to use Regulation Plan 1977-A as the primary basis for determining Lake Superior outflows. Flow changes resulting from the monthly regulation of Lake Superior are accomplished by varying the amount of water allocated to hydropower production, and when

necessary, by opening or closing gates in the Compensating Works at the head of the St. Marys Rapids.

Scheduled repairs to the Compensating Works resumed in May 1997 on Gates 11 and 12 and were completed in October. Repairs to the Canadian portion of the Compensating Works were completed in 1996. Repairs to the U.S. portion will be concluded in 1998 with Gates 9 and 10 being rehabilitated.

As with repairs in 1996 it was necessary to limit gate openings to assure safe access by the Contractor's personnel and equipment to the upstream side of the gates during the repair period. The International Lake Superior Board of Control (ILSBC) determined that the reduced capacity of the Compensating Works could result in a small amount of water being retained on Lake Superior during the repairs. In order to minimize adverse impacts on Lake Superior levels, the ILSBC recommended, and the International Joint Commission (IJC) approved the discharge of extra water from Lake Superior prior to the start of repairs.

As spring ice conditions permitted, the gates were opened from the winter one-half gate equivalent open setting to an equivalent 3 gates open in April. On May 6, when ice conditions permitted, eight gates were fully opened. On May 12, an additional two gates were opened, for a total of ten gates open (Gates #1 through #10). On May 19, two Gates (#9 and #10) were closed to allow the Contractor to start work on the site. Also, on the 19th, the contractor's tugboat *Venture* sank at Gate #8 while working upstream of the Compensating Works. The sinking required gate closures for several days to facilitate recovery operations, which were completed on May 24. This resulted in a

minor reduction in the anticipated May outflow. Lake Superior outflows were slightly below those specified by the regulation plan (Plan 1977-A) in May, June and July. Gate settings called for during June and July (9 and 10 gates, respectively) exceeded the number of Compensating Works gates physically available at the time. Consequently, during this period, the spillway gates next to the U.S. Government hydropower plant were used to make up some of the lost capacity at the Compensating Works.

Beginning in August, four gates were available to meet the recommended Plan 1977-A outflow. It is estimated that the maximum cumulative impact of the flow reductions due to the repair work was about a one inch rise on Lake Superior and about a one-half inch lowering of Lakes Michigan-Huron. The extra water was discharged and the impacts were dissipated by the end of September when the lakes were at the levels they would have been had Plan 1977-A been strictly applied during the repair period.

On August 5, the tugboat *Venture* again sank and was pinned against Gate #4. Gates were again closed to facilitate recovery operations, which were completed on August 8. No deaths occurred in either the May or August incidents. One of the *Venture's* crew suffered minor injuries in the August incident.

August through December outflows were as specified by Plan 1977-A. Figure 2 compares the monthly Lake Superior outflows in 1997 with the long-term average flows. In September, the Compensating Works gates were set at an equivalent one-half gate open setting in the St. Marys Rapids area. This gate setting is expected to remain through the 1997-1998 winter period until April 1998.

Renovation of the generating units at the U.S. Government hydropower plant at the St. Marys Falls Canal (Soo Locks) was completed and the plant came back on line in March. Unit 10 was also down for repairs during the June to December period. Figure 3 shows the generator room of the U.S. Government hydropower-plant during the repair period.

Lake Ontario Regulation

During the month of December 1996, Lake Ontario was at 245.08 feet, about 7 inches above its long-term average. Due to mild temperatures and the absence of ice in the St. Lawrence River, the I-Limit of the regulation plan was waived between December 14, 1996 and January 3, 1997

Lake Superior Outflows

1997 Monthly Mean
and Long-term Average (1900-1989)

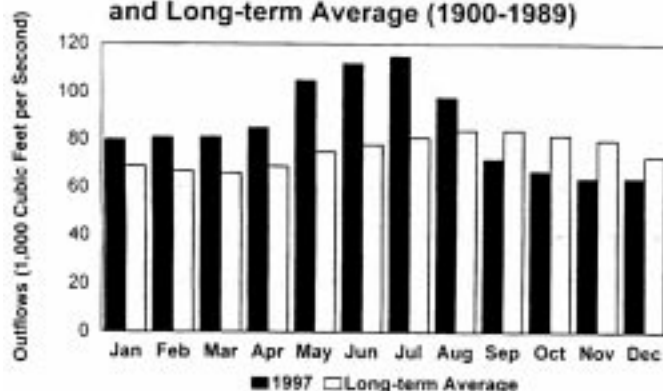


Figure 2

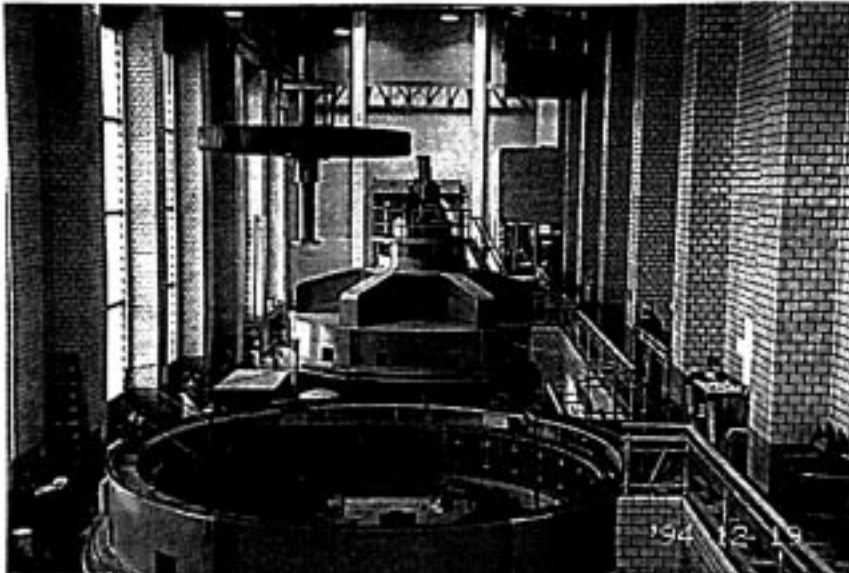


Figure 3: View of main generator room at the U.S. Government hydropower plant during repairs. The total capacity of the hydropower facility is about 18,400 KW.

and high outflows were discharged during this time. The average outflow was about 300,000 cubic feet per second (cfs) (with the highest about 325,000 cfs) while ships continued to transit along the international reaches of the St. Lawrence River. The outflows were considered to be the maximum possible to avoid unsafe cross-currents and velocities in the Seaway. A total of 36 flow changes were made in December in order to maximize the outflows while maintaining safe navigation. These short-term flow reductions took place in order to prevent Lake St. Lawrence levels from falling below 237.86 feet, the minimum level acceptable for navigation at this location. The Lake Ontario outflow for December 1996 was about 30% above the average and about 50,000 cfs more than that specified by Plan 1958-D. Figure 4 shows a comparison of 1997 monthly outflows with the long-term average monthly outflows.

On January 17, due to a significant rise in water levels and forecasted wet meteorological conditions, the International St. Lawrence River Board of Control (ISLRBC) received approval from the (IJC) to invoke Criterion (K). This criterion states that Lake Ontario will be operated strictly for the benefit of the riparians both upstream and downstream on the St. Lawrence River. By the end of January, Lake Ontario had risen to 245.70 feet, about 13 inches above the long-term average.

From January 17 through January 31, the outflow was reduced in order to accelerate ice formation at the various

parts of the St. Lawrence Seaway. The weekly outflow averaged about 233,000 cfs for that period. Once the ice formation was completed, the outflow was gradually increased to a high of about 311,000 cfs for the week ending March 7. The average supply into Lake Ontario for March was about 366,000 cfs. By the end of March, Lake Ontario rose to 246.10 feet, about 14 inches above the long-term average.

The supply to Lake Ontario exceeded the outflow for the period January 1 through May 23 with the exception of 2 weeks in February. There were several major constraints that were limiting factors in maximizing the outflow during this period. One was the fact that some parts of the St. Lawrence River started to exceed the flood stage in March, such as at Summerstown, Ontario. The level at

Summerstown was 13 inches above its long-term average, equaling the maximum recorded. Once navigation commenced on April 2, the level at Long Sault Dam, near Long Sault, Ontario, had to be maintained at 237.86 feet. When the outflow is very high at the Moses-Saunders powerhouse in Massena, NY the water levels upstream (for about 50 miles) of the powerhouse tend to be "drawn down". Since the outflow was so high, at times the outflow had to be reduced just to keep the level from falling below the required minimum depth for shipping at Long Sault Dam. Flooding also occurred in some parts of Lake St. Louis and Montreal Harbor. There were ice jam problems at the powerhouse at Beauharnois, Quebec,

Lake Ontario Outflows

1997 Monthly Mean
and Long-term Average (1900-1990)

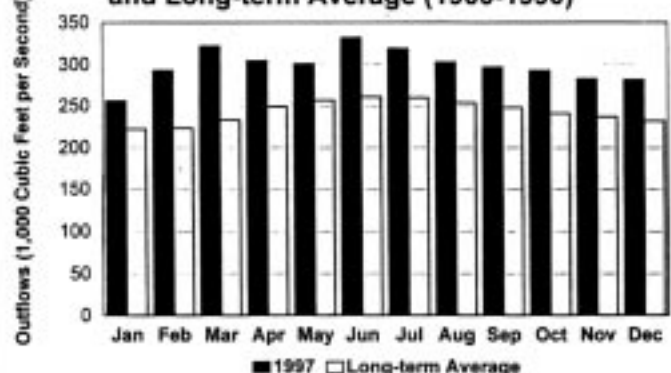


Figure 4

which required flow reductions as well. In May, when the Ottawa River freshet occurred, Lake Ontario outflows were again reduced for a few weeks to accommodate the flow increase to Montreal Harbor. Even though the flood stage of 73.16 feet at Pointe Claire in Montreal was never exceeded during this period, the levels were just below the flood stage during the entire period.

The Lake Ontario level peaked in late May at 247.28 feet and was about 10 inches above the long-term average for June. Once the Ottawa River freshet was completed, the Lake Ontario outflow was increased to over 318,000 cfs for the next 8 weeks, commencing on May 24. One major complaint to the ISLRBC was made by the recreational boaters and marina operators in the Lake St. Lawrence area where they experienced very low water levels due to the high discharge at the powerhouse in Massena.

During July and August, the level of Lake Ontario continued to drop to 246.13 feet, about 6 inches above average. Due to the relatively high Lake Ontario outflow, the Lake St. Lawrence levels were well below average with levels at Long Sault Dam being about 20 inches below average. On August 15, the IJC revoked Criterion (K) and the ISLRBC initiated a program of flow reduction to help avoid extremely low levels on Lake St. Lawrence. For the next 6 weeks ending on September 22, the Lake Ontario outflow was set at about 7,000 cfs below the operational Plan 1958-D outflow. Still, the level on Lake St. Lawrence at Long Sault was about 17 inches below average for September.

During October, due to the low levels in Lake St. Lawrence, the ISLRBC began another program of reducing the outflow to help the recreational boaters haul their boats into the marina. The outflow was again reduced by about 7,000 cfs below the operational Plan 1958-D outflow for just 4 days (2 consecutive weekends). By this time, another factor started to affect the maximum discharge. It was the strong easterly winds which began to "push" down the levels at Long Sault and hampered navigation. Numerous short-term flow reductions were made to increase the level at Long Sault in order to keep navigation going. However, 2 occurrences (1 in mid-November and 1 in mid-December) occurred which halted navigation temporarily. In both incidents the stoppage was due to the easterly winds driving the levels downward. A total of 180 vessel hours of stoppage was reported.

As in the past, it is impossible to tell what supplies will be received by Lake Ontario during the next 6 months. However, based on conditions of the upper lakes, the

likelihood of wet supplies remains high. The ISLRBC's current strategy is still to discharge the maximum possible while permitting navigation to continue. The last ship passed through the St. Lawrence Seaway on December 26, 1997 essentially ending the navigation season. Until the ice on the St. Lawrence River begins to form, the outflow will be increased to the maximum as long as flooding downstream of Massena does not occur.

Meetings With The Public

On June 17, 1997 the International Lake Superior Board of Control held a public meeting in Thunder Bay, Ontario. In connection with this meeting, a tour was given by the Lakehead Region Conservation Authority of Thunder Bay areas affected by high water levels.

On October 30, 1997 the International Niagara Board of Control held a public meeting at Niagara-on-the-Lake, Ontario.

In early 1994, the ISLRBC was tasked to evaluate two new regulation plans for Lake Ontario. One plan, Plan 35P, is a product of the IJC Levels Reference Study completed in 1993 and is a modified version of the current regulation plan. The other plan, the Interest Satisfaction model, which uses an optimization technique to achieve the best possible compromises among all interests. Plan 35P was recommended as the new regulation plan by the ISLRBC and on June 2, the ISLRBC sent the report to the IJC for their approval. Plan 35P was subsequently renamed Plan 1998 to coincide with the proposed year of its implementation. The report is entitled "An Updated Regulation Plan for the Lake Ontario-St. Lawrence River System" and can be obtained by notifying the U.S. Army Corps of Engineers in Buffalo.

The ISLRBC and the IJC held 6 public hearings jointly to present and receive public comment on the new regulation model discussed above. Three meetings were held in Canada and three in the U.S. The three cities in Canada were Burlington, Ontario (Oct. 9), Dorval, Quebec (Oct. 16) and Kingston, Ontario (Oct. 29). The three cities in the U.S. were Brockport, NY (Nov. 12), Sodus Point, NY (Nov. 13) and Massena, NY (Nov. 20). The IJC is presently assessing the report and public opinions about Plan 1998.

Commercial Navigation

As of the end of 1997, tonnage passing through the Soo Locks at Sault Ste. Marie, MI was about 8% above the comparable 1996 tonnage. United States and Canadian

vessels carried about 59 and 17 million short tons of cargo respectively, while foreign vessels carried about 4.5 million short tons. Foreign cargo traffic was up about 11% over comparable 1996 traffic. Through November, a total of 4,232 cargo vessels had transited the locks, as compared to 3,930 passages the previous year. Of these, 2,450 passages were U.S.-flagged vessels, 1,298 were Canadian-flagged, and 484 were foreign vessels (ocean-going or "salties"). In addition to the cargo vessels, there were also 6,273 transits by other types of vessels, such as pleasure craft, tour boats, Coast Guard, and scientific research vessels. The Corps of Engineers has the authority to keep the locks open until January 15, 1998, should shipping interests request it.

According to the St. Lawrence Seaway Development Corporation's preliminary figures through the end of November, 1997, 33.5 million metric tons (MMT) of cargo moved through the Lake Ontario-Montreal section of the Seaway. This was about 1.1 MMT less than in 1996. As of the end of November, the total number of vessel transits was 2,558 (1,560 lakers and 998 ocean vessels), as compared to 2,443 (1,458 lakers and 985 ocean vessels) in 1996.

Seaway officials reported preliminary information on a number of individual cargoes as of the end of November 1997, including: iron ore (down 1% to about 9.6 MMT); grain (up 9% to about 11.7 MMT); coal (about the same at about 0.5 MMT); and petroleum products (about the same at about 1.0 MMT).

1997 Great Lakes Updates

In 1997 the following *Great Lakes Updates* were published:

"1996 Annual Summary", Vol. No. 126, published January 3, 1997.

"High Water Level Concerns", Vol. No. 127, published April 2, 1997.

"Frequently Asked Questions", Vol. No. 128, published June 5, 1997.

"Great Lakes Storms", Vol. No. 129, published September 5, 1997.

General Notes:

All elevations shown in this article are referenced to the IGLD 1985 datum.

Information about the Great Lakes is available on the World Wide Web. The Internet address for the Detroit District's Home Page is as follows:

<http://sparky.nce.usace.army.mil>

Information is updated monthly.